JPRS 75567

25 April 1980

USSR Report

PHYSICS AND MATHEMATICS

No. 63

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

JPRS 75567

25 April 1980

USSR REPORT

PHYSICS AND MATHEMATICS

No. 63

CONTENTS

CRYSTALS AND SEMICONDUCTORS 1

Scientists Discover Semiconductor Recombination Wave Phenomenon [Article by A. Valentinov, SOTSIALISTICHESKAYA INDUSTRIYA special correspondent: "Wave Rushes Through Crystal"] 1

CLASSICAL MECHANICS 3

An Exact Solution of the Problem of the Motion of a Gimbaled Gyroscope 3

CRYSTALS AND SEMICONDUCTORS 4

Crystal Structure of $Cd(CH_3COO)_2 \cdot 2CSN_2H_4$ 4

Investigation of Phonon-Phonon Relaxation in Neutron-Doped and Ordinary Silicon Crystals 4

On the Nature of p-n Conversion of Ion-Bombarded InSb Crystals 5

Dielectric Spectra of KDP-DKDP Mixed Crystals in Submillimeter Range . 6

Use of Saphire Tubes Produced by the Stepanov Method as Envelopes for Laser Pumping Lamps 6

Using Shaped Single Crystals in Flashtube Pumping Systems 7

CONTENTS (Continued)

Using Single Crystal Tubes for Temperature Balancing in the Active Medium of a Solid-State Laser 8

The Czochralski-Stepanov Method 8

Formation of Defect Structure in Shaped Crystals of Optical Corundum . 9

ELECTRICITY AND MAGNETISM 10

Crack Propagation Under the Action of an Electromagnetic Field 10

Photoinduced Change in Magnetization of $CdCr_2Se_4$ Magnetic Semiconductors 10

FLUID DYNAMICS 12

Preferred Wave Numbers of Two-Dimensional Perturbations in the Problem of Convection in a Horizontal Layer 12

Linear Vortex Theories of Airfoils and Wings with Air Scoops 12

Effect of Compressibility on the Vortical Turbulence Spectrum 13

Convective-Film Cooling of Turbine Nozzle Vanes 14

Unsteady Boundary Layer of a Plate with Timewise Intermittent Suction 14

A Variant of the Enskog-Chapman Method Applied to a Boundary Layer with Fast and Slow Relaxation Processes 15

On the Hydrodynamics of Structural Relaxing Fluids 16

A Comparison of Asymptotic and Numerical Results in a Theory of Hypersonic Flow Around Blunted Solids 17

LASERS AND MASERS 18

The Electrical Discharge Characteristics of a Pulsed CO_2 Laser 18

Emissive Characteristics of Xenon in Rarefied Plasma 19

Investigation of Heat Transfer in the Active-Element Channel of Solid-State Lasers 19

CONTENTS(Continued)

MAGNETOHYDRODYNAMICS 20

Instability of a Conducting Viscous Fluid Layer Surrounding a Solid Rod 20

Discharge Contraction in a Molecular Electronegative Gas 20

The Parameters of Stabilized Electron Beams in the Upper Atmosphere .. 21

NUCLEAR PHYSICS 22

The LIU-10 High-Power Electron Accelerator 22

Acceleration of Thermal Neutrons by Isomeric ^{152m}Eu Nuclei 22

OPTICS AND SPECTROSCOPY 24

Resonant Raman Scattering in ZnTe at High Excitation Levels 24

STRESS, STRAIN AND DEFORMATION 25

On the Question of the Accumulation of Damage in Polymers 25

THEORETICAL PHYSICS 26

The Group Expansion Method in Quantum Kinetic Theory 26

CRYSTALS AND SEMICONDUCTORS

SCIENTISTS DISCOVER SEMICONDUCTOR RECOMBINATION WAVE PHENOMENON

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Mar 80 p 3

[Article by A. Valentinov, SOTSIALISTICHESKAYA INDUSTRIYA special correspondent: "Wave Rushes Through Crystal"]

> [Text] On 6 March a scientific discovery was registered under No 226 at the USSR State Committee for Inventions and Discoveries. "Phenomenon of Occurrence of Recombination Waves in Semiconductors" is the title of this scientific study authored by Doctors of Physics-Mathematical Sciences S. Kalashnikov, O. Konstantinov, V. Perel', and Candidates of Physics-Mathematical Sciences G. Tsarenkov, I. Karpova, B. Kornilov, and Yu. Zavadskiy.

Every metal melts in its own way. Germanium does this with aristocratic elegance, if we may phrase it in this manner. It initially incandesces white, and then an icy mirror appears in the crucible almost instantaneously -- a heavy liquid mass sparkling with a cold luster.

Irina Vladimirovna Karpova, staff member at the USSR Academy of Sciences Institute of Radio Engineering and Electronics, decided to acquaint me with the essence of this discovery, from the point of departure, as it were -- from the process of growing the semiconductor crystal itself. After it had cooled, it was cut up into small pieces. Contacts were soldered to the ends of one piece. Then the experiment proper began: the semiconductor was connected to a flashlight battery, and this circuit was connected to an oscilloscope. Wavy lines appeared on the oscilloscope screen.

This made no impression on me. Irina Vladimirovna hastened to explain: "We have applied direct current to the semiconductor, and yet a pulse signal has appeared on the oscilloscope. This means that the crystal has been transformed into an alternating-current generator. Herein lies the essence of our discovery...."

At this point we must recall the universally-known fact that electric current is the movement of electrons. But in semiconductors there is movement, in addition to electrons, of... "holes."

"Holes" is a term in physicist's jargon. In actual fact it is approximately the same as a hole in a doughnut -- an empty place from which an electron has just "departed." Nevertheless these empty spots move through a semiconductor, just as electrons, but in the opposite direction. And most important, just like electrons, they have their own... "lifetime."

Leningrad theoretical physicists O. Konstantinov, V. Perel', and G. Tsarenkov advanced the hypothesis that under the most ordinary conditions semiconductors can generate alternating current. But for this it is necessary that the "lifetime" of electrons and "holes" differ greatly from one another. How can this be accomplished? The Leningrad scientists proposed doping the semiconductor with certain substances. At this stage Moscow scientists joined the project. At the Institute of Radio Engineering and Electronics they worked with germanium, and at the Pulsar Scientific Research Institute -- with silicon. Through their joint efforts the scientists were able to prove the correctness of the theory. In addition they found doping materials which "exhibit" new properties of semiconductors. In 1968 they reported this newly-discovered phenomenon at an international conference. Why is the discovery only now being registered?

"We spent so many years looking for facts which would not fit into the proven theory," stated Candidate of Physics-Mathematical Sciences B. Kornilov.

"Have you found them?" "Not yet...."

But these years did produce results: the obtained semiconductor materials have proven indispensable as highly-precise tracers. They reacted to negligible changes in magnetic field, light flux, pressure, temperature, and shower of charged particles. And this meant that science, technology and industry can produce highly sensitive sensors monitoring the most subtle processes. And add to this the possibility of building devices which can convert light, electrical and mechanical signals into electromagnetic.
[130-3024]

3024
CSO: 1862

CLASSICAL MECHANICS

USSR UDC 531.383

AN EXACT SOLUTION OF THE PROBLEM OF THE MOTION OF A GIMBALED GYROSCOPE

Moscow DOKLAY AKADEMII NAUK SSSR in Russian Vol 250 No 4, 1980 pp 823-825
manuscript received 17 Jul 79

KHARLAMOV, M. P., Donetsk State University

[Abstract] A gyroscope with design flaws is considered. Such flaws are taken into account in, e.g. the analysis of drift. An exact solution of the problem of the motion of this gyroscope in gimbals, is presented on the basis of A.A. Bogoyavlenskiy's indication of the conditions for separation of variables in the case in which the axis of an unbalanced gyroscope is horizontal (expressing the time dependence of the principal variables by means of elliptical functions). To this end, a system consisting of three bodies (outer ring, inner ring, and rotor) is examined in specific inertial frames. It is shown that the configuration of the system is determined by three Lagrangian coordinates. Formulas for the kinetic energy and potential energy of the system are presented. It is shown that the entire possible range of permissible values of the integration constants k, yields 16 different types of trajectories in the configuration space. These types can be readily described qualitatively. References 10 Russian.
[103-1386]

USSR UDC 548.736.6

CRYSTAL STRUCTURE OF $Cd(CH_3COO)_2 \cdot 2CSN_2H_4$

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 4, 1980 pp 852-854 manuscript received 21 Sep 79

BONDAR', V. I., RAU, V. G., STRUCHKOV, YU.T., AKIMOV, V. M., MOLODKIN, A. K., ILYUKHIN, V. V. and BELOV, N. V., Vladimir State Pedagogical Institute imeni P. I. Lebedev-Polyanskiy

[Abstract] The structure of the Cd-polyhedron and of the compound $Cd(CH_3COO)_2 \cdot 2CSN_2H_4$ as a whole was investigated by means of x-ray structural analysis, using the Paterson method with subsequent construction of γ'-synthesis. Reflections were observed with the aid of the Syntex $P2_1$ MoK diffractometer. The parameters of the crystal structure of rhombic $Cd(CH_3COO)_2 \cdot 2CSN_2H_4$ were found to be: $a = 11.805 \pm 0.002$, $b = 15.438 \pm 0.003$, $c = 7.582 \pm 0.002$ Å. The resulting values of atomic coordinates and their anisotropic (isotropic for hydrogen atoms) thermal corrections are tabulated, as are the principal interatomic distances and angles in discrete fragments of the structure. Judging from the results of structural analysis, this compound can be assigned either the coordination number 4 with the nearest tetrahedral surrounding of the atoms of S, S', O_1 and O_1', or the coordination number 6 ("twin-capped" tetrahedron) with inclusion of the atoms of O_2 and O_2' in the coordination tetrahedron. Figures 2; references 9: 4 Russian, 5 Western.
[103-1386]

USSR UDC 621.315.592

INVESTIGATION OF PHONON-PHONON RELAXATION IN NEUTRON-DOPED AND ORDINARY SILICON CRYSTALS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 14 No 2, Feb 80 pp 302-305 manuscript received 26 Jun 79

BARANSKIY, P. I., SAVYAK, V. V. and SHCHEBRINA, L. A., Institute of Semiconductors, Academy of Sciences UkrSSR, Kiev

[Abstract] Experience has shown that silicon crystals doped with ^{31}P by transmutation of ^{30}Si atoms under thermal neutron bombardment have higher homogeneity of dopant distribution and higher values of mobility than crystals doped by adding phosphorus to the melt. The authors examine the question of whether neutron-doped silicon crystals show similar advantages over ordinary crystals with respect to criteria involving scattering of phonons rather than electrons, which is equivalent to an improvement in the resolution of

scatters (defects), since the de Broglie wavelength of even the longest-wave phonons is shorter than the electron wavelength. The analysis is based on a study of phonon-phonon relaxation at T = 85 K in terms of the theory of anisotropic scattering. Experimental data are used that were obtained by measuring the piezothermo-emf as a function of magnetic field strength in the electron-phonon drag region in n-Si neutron-doped crystals. It is shown that residual defects that arise with transmutation doping have no noticeable effect directly on the electron subsystem, and cause a considerable change in effects that involve long-wave phonons. The authors thank A. G. Samoylovich for discussing the results. Figures 2, references 7: 3 Russian, 4 Western.
[128-6610]

USSR UDC 621.315.592

ON THE NATURE OF p-n CONVERSION OF ION-BOMBARDED InSb CRYSTALS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 14, No 2, Feb 80 pp 306-310 manuscript received 26 Jun 79

BLAUT-BLACHEV, A. N., GERASIMENKO, N. N., LEZHEYKO, L. V., LYUBOPYTOVA, YE. V. and OBODNIKOV, V. I., Institute of Physics of Semiconductors, Siberian Department, Academy of Sciences USSR

[Abstract] An investigation is made of the behavior of conductivity and effective mobility at 77 K in layers of p-InSb subjected to bombardment with ions of Ne^+, Ar^+ and Kr^+. The initial material was doped with Cd, Zn or Ge. It was found that irradiation with inert ions at 250-300°C, or at room temperature with subsequent annealing at 250-300°C produces a layer of n-type conductivity only in germanium-doped InSb with a hole concentration of the order of 10^{14} cm^{-3} or less, and that p-n conversion does not occur at all when the initial material is doped with Cd or Zn. It is concluded that ion bombardment combined with heat treatment produces structural changes that alter the electrical state of the amphoteric dopant, causing p-n conversion. The depth of the converted layers depends on the state of the surface, and in particular on the type of coating. Figures 2, references 11: 8 Russian, 3 Western.
[128-6610]

USSR

DIELECTRIC SPECTRA OF KDP-DKDP MIXED CRYSTALS IN SUBMILLIMETER RANGE

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 11, 1979 pp 3304-3309 manuscript received 29 May 79

VOLKOV, A.A. and KOZLOV, G.V.

[Abstract] Frequency dependence of dielectric permeability in the region of fundamental dispersion is a major source of information on the mechanism responsible for phase transitions in ferroelectric crystals. Temperature-unstable lattice vibrations at the phase transition temperature lead to spontaneous polarization in the crystal. In conformity with the anomalous temperature behavior of the ferroelectric soft mode, the region governed by its dispersion also shifts toward the lower frequencies. In mixed crystals, the frequency of ferroelectric modes falls anomalously at the phase transition temperature. Typical dispersion frequency of transverse dielectric permeability also drops with a rise in the degree of deuterization. References 20: 5 Russian, 15 Western.
[92-8617]

USSR UDC 548.55

USE OF SAPHIRE TUBES PRODUCED BY THE STEPANOV METHOD AS ENVELOPES FOR LASER PUMPING LAMPS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 44, No 2, Feb 80 pp 386-388

SAPRYKIN, L. G., BRAILOVSKIY, V. B., GAYDUKOV, YE. N., YEGOROV, L. P., ZATULOVSKIY, L. M., KRAVETSKIY, D. YA., LEONOV, G. S. and RYZHKOV, A. YE.

[Abstract] The best pumping sources for YAG-Nd lasers are based on discharge in alkali metal vapors. Since alkali metals attack quartz glass, the envelopes for alkali vapor arc lamps are made of alumina. Polycrystalline aluminum oxide has diffusing properties that are determinental to focusing, and hence reduce the efficiency of the laser pumping system. Suitable envelopes for pumping lamps are now being made by drilling, grinding and polishing single crystal Al_2O_3 rods grown by the Czochralski method. In this paper the authors study the feasibility of using sapphire tubes grown by the Stepanov method as lamp envelopes. The equipment and technique used for growing the tubes are described in a previous article [see L. P. Yegorov, L. M. Zatulovskiy, D. Ya. Kravetskiy et al., IZV. AN SSSR: SER. FIZ., Vol 42, 1979, p 1947]. The tubes were 4.6 and 7 mm in diameter with walls 0.5, 0.75 and

1.0 mm thick. Growth rate was 2 mm/min, and inside and outside diameter were held within a tolerance of 0.1 mm. The tubes were annealed and used as envelopes without further mechanical or chemical treatment. The lamps were filled with Xe-K-Rb and niobium caps were sealed on the ends with $CaO-Al_2O_3-MgO$ cement. Comparative tests show that the apparent diameter of the arc with sapphire envelopes is at least 1.5 times smaller than for a polycrystal alumina envelope. This is in agreement with envelopes made by drilling out single crystals of Al_2O_3 grown by the Czochralski method. Figures 2, references 6: 4 Russian, 2 Western.
[126-6610]

USSR UDC 548.55

USING SHAPED SINGLE CRYSTALS IN FLASHTUBE PUMPING SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 44, No 2, Feb 80 pp 389-392

BALASHOV, I. F., BEREZIN, B. G., BUCHENKOV, V. A., YEVDOKIMOVA, V. G., YEGOROV, L. P., ZATULOVSKIY, L. M., KRAVETSKIY, D. YA., POLYAKOV, M. I., STEPANOV, A. I. and KHANKOV, S. I.

[Abstract] Flashtube pumping systems for stimulating the active medium of solid-state lasers frequently use parts of complex configuration made of transparent material. These monoblocks are ordinarily used in lasers with forced cooling by fluid flowing in channels through the illuminator. It is shown that natural heat transfer can be used in such pumping systems when the illuminator is made from a single crystal of a material with a high coefficient of thermal conductivity such as leucosapphire, magnesite, garnet, beryllium oxide and so on, thus considerably reducing the temperature of the active medium. The proposed method of heat reduction is based on the increased effective coefficient of heat transfer from the active element to the ambient medium when the heat source is provided with fins. Leucosapphire is hard to machine, and for certain shapes of monoblocks, it is practically impossible to use conventional machining techniques. The authors have used the Stepanov method to grow monoblocks for flashtube pumping systems with natural heat transfer. Crystals of high optical quality were grown with diameter of up to 28 mm. The openings in the monoblock for the flashtube and active element were 8.5 mm in diameter. Maximum length was 220 mm. The margin of accuracy for the shape of the holes was 0.1 mm, and for the outside diameter of the monoblock the accuracy was 0.1-0.2 mm. The growth rate must be held to 0.5mm/min or less to ensure satisfactory transparency. Thermal stresses were kept low by using special measures to ensure a low temperature gradient in the crystallization zone. The monoblocks produced in this way did not crack when cut, even without annealing. Surface quality was good enough for use in

lasers without further mechanical or chemical treatment. Sapphire monoblocks grown as a single crystal give a gain in maximum pumping power of a factor of about 10 as compared with tubular illuminators. Figures 2, references 4 Russian.
[126-6610]

USSR UDC 548.55

USING SINGLE CRYSTAL TUBES FOR TEMPERATURE BALANCING IN THE ACTIVE MEDIUM OF A SOLID-STATE LASER

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 44, No 2 Feb 80 pp 393-396

BALASHOV, I. F., BEREZIN, B. G., YEGOROV, L. P., ZATULOVSKIY, L. M., KRAVETSKIY, D. YA., PIS'MENNYY, V. A., POLYAKOV, M. I. and KHANKOV, S. I.

[Abstract] One of the simplest ways to reduce temperature imbalance in the active element of a solid state laser is to enclose it in a transparent tube with high thermal conductivity. It is shown that the optimum material for such a tube is single crystal leucosapphire. Since this material is not easily machinable, the authors propose growing the tubes from the melt by the Stepanov method. Tubes were grown by this method with diameters ranging from 6 to 20 mm, and wall thickness from 0.5 to 4.0 mm. These tubes were annealed and used in neodymium-doped and YAG lasers without further mechanical or chemical treatment. For an average pumping power of about 25 W these sapphire tubes effectively stabilize emission energy, reducing the wedge deformation and temperature of the active element, and enabling continuous operation for about 3 minutes. Figures 3, references 8: 7 Russian, 1 Western.
[126-6610]

USSR UDC 532.63

THE CZOCHRALSKI-STEPANOV METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 44, No 2, Feb 80 pp 397-399

PANKOV, V. M.

[Abstract] The author considers the process of crystal growing by the Czochralski method when the ratio of crystal diameter r to crucible diameter R is close to unity. Analysis of the stability of the crystallization process

shows that the Czochralski method begins to acquire the features of the Stepanov method when $r/R \sim 1$, the overall stability of the crystallization process being maintained due to capillary stability. It is shown that in this case the overall stability is intensified by an increase in one of the coefficients in the thermal equation. Intensification of stability of the crystallization process will become appreciable at low temperature gradients within the crystal. As the crystallization front moves into the heater cavity, the temperature gradient in the crystal must be considerably reduced. The deterioration of thermal stability of the process due to the reduced temperature gradient in the crystal will be compensated by the large value of r/R. This technique is called the Czochralski-Stepanov method. For comparison, crystals of silicon were grown by the Czochralski method with average diameter of 41 mm from a crucible 135 mm in diameter and 60 mm high with a charge of 1.5 kg, and by the Czochralski-Stepanov method with average diameter of 35 mm from a crucible 40 mm in diameter and 150 mm high with a charge of 0.37 kg. The maximum deviation from the average diameter for the Czochralski crystals was ±1.5 mm, and for the Czochralski-Stepanov crystals -- ±0.3 mm. Figure 1.
[126-6610]

USSR UDC 548.552

FORMATION OF DEFECT STRUCTURE IN SHAPED CRYSTALS OF OPTICAL CORUNDUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA FIZICHESKAYA in Russian Vol 44, No 2 Feb 80 pp 400-403

MUSATOV, M. I., NIKOLAYEV, I. N., PETUNINA, I. N. and IVANOV, B. G.

[Abstract] Corundum single crystals grown by the Stepanov method have limited applicability due to low quality. The main defects in these crystals are blocks, relatively high dislocation density and gas inclusions. The authors investigate the causes of blocks and dislocations in optical corundum crystals. It is shown that the block structure forms only when the optical axis is perpendicular to the direction of crystal pulling and to the plane of plates grown by the Stepanov method. This is attributed to the coincidence of the directions of action of stresses due to temperature gradients and the directions of possible slipping along prisms of the first and second kinds. Conditions are determined for growing crystals of zero orientation without block defects by the Stepanov method. It is shown that dislocations are formed mainly along slip planes in regions with high stresses. Diffusion processes play a part in the formation of both blocks and dislocations. A comparison of the conditions of growth of corundum crystals of zero orientation by different methods shows that the rates of diffusion of vacancies in the crystal lattice are different in different directions. Figure 1, references 11 Russian.
[126-6610]

USSR UDC 539.375.5

CRACK PROPAGATION UNDER THE ACTION OF AN ELECTROMAGNETIC FIELD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 5, 1980 pp 1096-1100 manuscript received 7 Jul 79

PARTON, V. Z., KUDRYAVTSEV, B. A. and RUBINSKIY, B. D., Moscow Institute of Chemical Machine Building

[Abstract] The effect of the electromagnetic field on the processes of deformation and heat conduction in a crack in a metal specimen is theoretically investigated for an unbounded plate of a current-conducting material in which there instantaneously arises a semiinfinite nonconducting crack located along the negative semiaxis $x<0$, $y = 0$. Formulas for the intensity vectors of electrical and magnetic fields are presented, as is a formula for the perturbation of the magnetic field due to the presence of the crack. The temperature state of the crack is derived from the quasistatic formulation of the related thermoelasticity problem. Corresponding formulas for the stressed state indicate that in the neighborhood of the crack apex there arise compressive thermal stresses which may inhibit the propagation of a crack developing under the action of specified mechanical loads. It is thus shown that the instantaneous formation of a crack in a current-conducting plate results in the fusion of the crack apex with the formation of a microcrater which reduces the concentration of mechanical stresses, owing to the attendant increase in the radius of curvature of the crack apex. Figure 1; references 7 Russian.
[119-1386]

USSR

PHOTOINDUCED CHANGE IN MAGNETIZATION OF $CdCr_2Se_4$ MAGNETIC SEMICONDUCTORS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 11, 1979 pp 3250-3254 manuscript received 16 Apr 79

RUDOV, S.G. and VESELAGO, V.G., Physics Institute imeni P. N. LEBEDEV, USSR Academy of Sciences, Moscow

[Abstract] Interaction of electronic and magnetic subsystems causes cross magnetic-optical-electrical effects in magnetic semiconductors. Photoexcitation of electrons in nondegenerate antiferromagnetic semiconductors may convert them to the ferromagnetic state. Magnetic semiconductor $CdCr_2Se_4$ undergoes photoinduced changes in magnetic properties. Intense laser emission

alters its magnetization. Chips with natural facet (111) 1 x 2.5 mm in size were measured; their thickness ranged from 0.3 to 1 mm. Deviation of magnetization from the stationary direction under the influence of exciting pulses is maximum in the absence of a magnetic field which stabilizes the direction of spin momentum. In the region of disappearance of the domain structure, the magnetic field inside the specimen differs from zero, and the S2 signal falls to inverse proportion to internal magentic fields. References 14:
10 Russian, 4 Western.
[92-8617]

FLUID DYNAMICS

USSR UDC 532.529

PREFERRED WAVE NUMBERS OF TWO-DIMENSIONAL PERTURBATIONS IN THE PROBLEM OF CONVECTION IN A HORIZONTAL LAYER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 4, 1980 pp 826-829
manuscript received 26 Jul 79

GETLING, A. V., Scientific Research Institute of Nuclear Physics, Moscow State University imeni M. V. Lomonosov

[Abstract] Thermal convection in a plane horizontal layer of a fluid heated from below is known to be characterized by a quasi-two-dimensional flow in the form of billows. The horizontal width distribution of these billows displays a maximum corresponding to some preferred width, or "preferred" wavelength. In this connection, the isolation of a preferred mode of convection from initial "noise" is investigated by considering a nonlinear problem with a continuous spectrum of perturbations and assuming that initially the velocity and temperature fields contain all possible wave numbers, including zero. Coordinate representations of solutions derived by the inverse Fourier transform are used to investigate the process of the formation of convective billows and to determine their wave numbers. A table is given of preferred wave numbers corresponding to the periodicity of steady-state billows generated by initial perturbations in the presence of 7 different values of Rayleigh and Prandtl numbers. It is shown that the preferred wave number decreases with increase in the Rayleigh number from 660 to 10^4, particularly in the presence of low Prandtl numbers. This effect may be attributed to the intrinsic properties of the mechanism of convection in an infinite horizontal layer. Figure 1; references 10: 2 Russian, 8 Western.
[103-1386]

USSR UDC 533.6.011.32

LINEAR VORTEX THEORIES OF AIRFOILS AND WINGS WITH AIR SCOOPS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 4, 1980 pp 829-833
manuscript received 18 Jul 79

SHURYGIN, V. M.

[Abstract] The linear problem of flow around a slender airfoil with an air intake is examined in the approximation of a flow around a flat plate from a source located on the plate at the point $x = x_A$, where the air intake is located. The problem is subdivided into symmetrical and antisymmetrical problems. A formula for the intensity of the vortex layer originating from the source is presented. It is shown that, with the exception of the first and last vortices, discrete vortices form in areas of the vortex layer positioned

symmetrically in relation to the vortex for slender airfoils, and that this also applies to finite-span wings with air intake. The resulting principle of construction of the original vortex layer is based on a continuation of the vortex lines in the form of lines aligned along the incident flow. The rules of similarity that generalize the linear theory of flow around airfoils with an air intake to transonic velocities are readily applied to finite-span wings if allowance is made for the variation in aspect ratio with variation in Mach number. Figures 2; references 5 Russian.
[103-1386]

USSR UDC 534.28

EFFECT OF COMPRESSIBILITY ON THE VORTICAL TURBULENCE SPECTRUM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 4, 1980 pp 849-851
manuscript received 3 Oct 79

MOISEYEV, S. S., TUR, A. V. and YANOVSKIY, V. V., Khar'kov Physico-Technical Institute, UkrSSR Academy of Sciences

[Abstract] The properties of strong turbulence in hydrodynamics and plasma are chiefly interpreted on the basis of the Kolmogorov-Obukhov theories of the spectral constancy of the energy flux P_k, so far as imcompressible fluids are concerned. Considering that compressible fluids represent another extreme, the effect of compressibility on the vortical component of turbulence in the presence of low Mach numbers is examined. It is shown that in the presence of relatively low compressibility the turbulence spectrum loses its self-similar nature owing to the effect of the Mach number. It also is shown that the violation of the Kolmogorov self-similarity principle is then due to the Mach number dependence of the energy density in wave number space. A corresponding formula for the vortical energy spectrum of compressible fluids at $M^2 \leq 1$ is derived. References 9 Russian.
[103-1386]

USSR UDC 536.27

CONVECTIVE-FILM COOLING OF TURBINE NOZZLE VANES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 6, Nov Dec 79
pp 1319-1327 manuscript received 14 Jul 78

ZIKEYEV, V. V., Moscow

[Abstract] The efficiency of convective or film cooling in gas turbines is determined not only by the maximum gas temperature that can be reached for given coolant and vane temperatures and by the required relative flowrate of air, but also by the extent of gasdynamic ideality of the system. Injection of air to produce the film involves additional energy losses between vanes. The general recommendation is to use convective cooling, and supplement it with film cooling in case of extreme necessity. In convective cooling the greatest difficulties arise in organizing cooling of the trailing edge of the vane because of the high heat fluxes from the gas and the reduced cooling capacity of the air that has been preheated by the leading edge. This may make it necessary to use convective-film cooling in this case. The author derives analytical relations for calculating the efficiency of convective-film cooling based on a heat sink model, assuming that velocity in the boundary layer changes according to a power law with exponent $n = 1/12$. The results show good agreement with experimental data obtained in testing film cooling of gas turbine nozzle blades in situ. Figures 4, references 22: 11 Russian, 11 Western.
[101-6610]

USSR UDC 532.517.2

UNSTEADY BOUNDARY LAYER OF A PLATE WITH TIMEWISE INTERMITTENT SUCTION

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 71-74 manuscript received 18 Apr 78

BEL'DEY, L.M. and KULONEN, L.A.

[Abstract] A flat plate is positioned in a plane parallel flow of a viscous incompressible fluid at a zero attack angle, and the plate extends downstream without limit. A uniformly distributed suction is suddenly applied to the surface at some point in time, and then removed just as suddenly at another time. It is assumed that the fluid or gas flowrate is small, the physical properties of the medium do not depend on the temperature, that the suction velocity normal to the plate is constant along the surface and is a timewise

step function. The problem of determining the nature of the change in the frictional stresses at the surface of the plate as a result of the intermittent suction is solved through a Fourier analysis of the basic nonsteady-state laminar boundary layer flow equation. Figures 2; references: 2 Russian
[104-8225]

USSR UDC 533.6.011.8

A VARIANT OF THE ENSKOG-CHAPMAN METHOD APPLIED TO A BOUNDARY LAYER WITH FAST AND SLOW RELAXATION PROCESSES

Leningrad VESTNIK LENINGRADSKOGO UNIFERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 87-93 manuscript received 25 Mar 78

NAGNIBEDA, YE.A. and LAPTEV, V.A.

[Abstract] The example of flow around a flat-semi-infinite plate is used to illustrate a modification of the Enskog-Chapman procedure for a boundary layer in a reacting mixture of gases with internal degrees of freedom. A method proposed in earlier literature for a simple gas is used to derive a system of transport equations and the formulas for the calculation of the flow terms in a first approximation. The detailed mathematical treatment starts with the introduction of the defining macroparameters in terms of the numerical densities of the various kinds of particles, their velocity, the mass velocity components and the temperature, subsequently utilizing the Enskog-Chapman procedure to find the time derivatives of these macroparameters and ultimately arrive at expressions in a viscous approximation for the stress tensor and the heat flux. It follows from the derived formulas that in a first approximation, the presence of internal degrees of freedom has no influence on the rate of diffusion and the stress tensor components, while the component of the heat flux vector in the direction of the y-axis (specified in the earlier literature) changes, as compared to a mechanical mixture of gases, due to the heat flux resulting from the transport of the energy of the internal degrees of freedom. References: 6 Russian.
[104-8225]

USSR UDC 532.20

ON THE HYDRODYNAMICS OF STRUCTURAL RELAXING FLUIDS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 94-98 manuscript received 27 Apr 78

SKVORTSOV, G.YE.

[Abstract] The formulation of a structural relaxation theory of hydrodynamics which describes the flow of fluid media of diverse classes in a wide range of conditions is broken down into three stages: the derivation of the fundamental closed system of equations and its general analysis; ascertaining the general functional form of the defining relationships and the formulation of the principles promoting their precise specification; the specification of the defining relationships with the utilization of general principles and experimental data. The paper is a general mathematical treatment of this theory which takes into account such phenomena as nonlinearity, retardation and nonlocality. The general analytical expressions adduced must be given a specific form depending on the various classes of fluids, an extremely complex problem which is to be solved semi-phenomenologically. The theory is promising for the description of turbulent fluid and complex fluid media flows, for the analysis of high intensity shock aves and explosive processes, as well as low amplitude processes in a full range of velocities and gradients, for the purpose of ascertaining the structure of the media. The general theory is illustrated for the specific case of a molecular gas, where the starting point is linearized equations for the mass balance, momentum and relaxation quantities: the specific energies of the translational and internal degrees of freedom. Specific analytical expressions are derived in this case for a monatomic gas and it is shown that the medium has six space-time scales; the characteristics of the structural kinetic components forming the medium are found from an analysis of the zeros of the governing function derived. This general theory was first presented in reports to a seminar on mechanics of the mathematical mechanics department of Leningrad State University on 17 June 1976 and 3 March 1977. References 4: 3 Russian, 1 Western.
[104-8225]

USSR UDC 533.6.011

A COMPARISON OF ASYMPTOTIC AND NUMERICAL RESULTS IN A THEORY OF HYPERSONIC FLOW AROUND BLUNTED SOLIDS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 118-120 manuscript received 9 Dec 78

ENGEL'GART, V.N.

[Abstract] An asymptotic interation procedure is employed to find the analytical solution of the steady-state problem of hypersonic flow around blunted solids in an ideal gas. The contours of the solids considered here are specified in the form of a power series; the asymptotic solution is compared with numerical calculations performed in earlier literature. The Mach number of the incident flow is taken as infinity and the ratio of the specific heats approaches unity. Data given in tabular form illustrate the range of validity and the efficiency of the asymptotic expansion used to calculate the pressure on an airfoil and the separation of the shock wave from it. References 8: 7 Russian; 1 Western.
[104-8225]

USSR UDC 621.378.33

THE ELECTRICAL DISCHARGE CHARACTERISTICS OF A PULSED CO_2 LASER

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 95 No 3, 1979 pp 569-572 manuscript received 4 May 79

BARKHUDAROV, E.M., BEREZOVSKIY, V.R., GELASHVILI, G.V., PETRUSHEVICH, YU.V., TAKTAKISHVILI, M.I. and CHELIDZE, T.YA., Institute of Physics of the Georgian SSR Academy of Sciences

[Abstract] Theoretical results computed for the discharge voltage and current, radiation output and concentration of electrons are compared with experimental results obtained using a pulsed CO_2 laser with double transverse discharge. The length of the semi-confocal resonator of the laser was 5 m and the active region was 3 m long. The ratio of the constituent gases, $CO_2:N_2:He$, was varied and the pressure in the 8.4 liter discharge volume ranged from 100 to 400 torr. A maximum output energy of 180 J was found for a mixture of $CO_2:N_2:He = 2:2:3$ at 400 torr, and the specific output energy in this case was about 44 J/l•atm. The system of differential equations used to describe the behavior of the concentration of electrons and ions, the gas temperature and the symmetric, antisymmetric and deformation modes of the CO_2 molecules as well as the N_2 vibrations are not shown, but it is indicated that they were supplemented with equations describing the behavior of the power supply circuit. Typical of the agreement between the theory and experiment are values for a mixture ratio of 3:3:4 where the output energy was 120 J (experimental) and 180 J (calculated). Reasons for the disparities are: the entire volume occupied by the discharge is not efficiently utilized; also, the calculated results depend a great deal on the values of the ionization and sticking coefficients, and the nature of their dependence on the ratio of the field intensity in the discharge to the concentration of neutral molecules. The greatest divergence was found in the computed time for the output pulse delay with respect to the current maximum, which was smaller than the experimental value by a factor of two to three. It is noted that this disagreement and others can be related to an entire series of processes which are not considered in the formulation of the equations. Still, the proposed system of equations can be used to calculate the parameters of a CO_2 discharge laser by adding a term describing the ionization due to the electron beam to the equation for the electron concentration. Figures 1; references 7: 3 Russian; 4 Western.
[102-8225]

USSR UDC 533.932

EMISSIVE CHARACTERISTICS OF XENON IN RAREFIED PLASMA

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17 No 5, 1979 pp 916-921 manuscript received 11 Apr 78

BUGROVA, A. I., YERMOLENKO, V. A. and KALIKHMAN, L. YE., Moscow

[Abstract] The absolute intensities of the spectral lines representing the emission spectrum of rarefied xenon plasma in crossed electric and magnetic fields were measured by calibrating them with respect to a standard source with a known absolute luminance. On the basis of these measurements the luminous energy emitted by the plasma within the optical wavelength range was estimated at 2-3 W in the source channel. It is shown that the population of the upper energy levels in the plasma is satisfactorily described by the coronal equilibrium model, and that knowledge of the absolute intensity of a line and of the optically determined electron temperature makes it possible, within the framework of the coronal model, to compute the product of the atom concentration and the electron concentration; given a known electron concentration, this provides an idea of the atom concentration in a given source. Figures 5; references 17: 13 Russian, 4 Western.
[107-1386]

USSR UDC 536.24

INVESTIGATION OF HEAT TRANSFER IN THE ACTIVE-ELEMENT CHANNEL OF SOLID-STATE LASERS

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17 No 5, 1979 pp 1061-1063 manuscript received 5 Dec 78

GENIN, L. G., KUZNETSOV, S. M. and SAYENKO, D. V., Moscow Energy Institute

[Abstract] The properties of the radiation generated by solid-state lasers are adversely affected by the heating of their active elements. This necessitates the use of cooling systems. In this connection heat transfer from the surface of the active element was experimentally investigated with respect to a water-cooled laser in which the active element was replaced by a stainless steel tube through which electrical current was passed. The range of Reynolds numbers considered varied from $2 \cdot 10^3$ to $14 \cdot 10^3$. The experimental data were used to derive a formula for the Nusselt number distributions as well as a formula for computing the heat transfer coefficients in the lamp channel and in the active-element channel of solid-state lasers with unit-body reflectors. These formulas are recommended for computing heat transfer from active elements and pumping lamps of this type of laser for the Reynolds number range considered. Figures 2; references 3 Russian.
[107-1386]

USSR UDC 538.4:532

INSTABILITY OF A CONDUCTING VISCOUS FLUID LAYER SURROUNDING A SOLID ROD

Riga MAGNITNAYA GIDRODINAMIKA in Russian No 4, 1979 pp 24-28 manuscript received 25 Apr 79

PRUDNIKOV, V. V.

[Abstract] Stabilization of MHD instabilities serves to introduce into a conductor sufficient energy to achieve a rapid and uniform vaporization of the conductor surface. In this connection, axisymmetric perturbations of a layer of viscous fluid with current flowing along its surface are analyzed in linear terms. The small-perturbation method is used to formulate the corresponding dispersion formula, from which estimates of the increment of instability in the presence of low and high wave numbers are derived. These estimates point to the existence of a certain wave number at which that increment is minimal. In both cases (low and high wave numbers) the increment is directly proportional to the square of current intensity, inversely proportional to viscosity, and independent of density. At high wave numbers this increment is also independent of the layer thickness (coincides with the Taylor estimate for a compressible viscous fluid column with surface current). References 6 Russian.
[108-1386]

USSR UDC 533.92

DISCHARGE CONTRACTION IN A MOLECULAR ELECTRONEGATIVE GAS

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 17, No 6, Nov Dec 79 pp 1153-1160 manuscript received 23 Jan 79

BYCHKOV, V. L. and YELETSKIY, A. V., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] Previous research on discharge contraction in electronegative gases has shown that the transition from vibrational to translational energy accompanying the discharge causes sharp temperature inhomogeneity in the discharge column. Continuing this research, the authors study the influence that exchange of energy between translational and vibrational degrees of freedom of molecules has on the mechanism and nature of contraction in molecular electronegative gases. An approximate method is worked out for simultaneous solution of the equation of balance of vibrational and translational energy and the equation of balance of charged particles with consideration of the way that ionization efficiency, sticking and neutralization of charged

particles depend on radius. The technique is based on the weak functional dependence between the solutions of these equations. The solution takes the form of a simple radial dependence with a single variable parameter that characterizes the scale of the drop in the unknown function from the axis toward the walls of the discharge tube. Solution of the resultant system of balance equations for electron density, and for the translational and vibrational temperature of the gas gives the conditions under which discharge contraction will occur. The results are compared with experimental data for discharge contraction in molecular oxygen, and the limits of applicability of the proposed theory are estimated. The authors thank B. M. Smirnov for supporting the work, and L. M. Biberman for constructive criticism. References 14: 11 Russian, 3 Western.
[101-6610]

USSR UDC 629.78:525.24

THE PARAMETERS OF STABILIZED ELECTRON BEAMS IN THE UPPER ATMOSPHERE

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 84-86 manuscript received 6 Jul 76

KOLESNIKOV, YE.K., KURYSHEV, A.P. and FILIPPOV, B.V.

[Abstract] The general problem of the injection of a relativistic electron beam into a rarefied plasma where the electron density is much less than the initial density of the electrons in the beam is briefly discussed. The beam is injected along the lines of force of a homogeneous magnetic field (in this case, the geomagnetic field is an additional stabilizing factor). While the question of beam stability is not treated, the theoretical possibility of relativistic beam localization in the upper atmosphere is considered. Based on derived analytical expressions, data are given in tabular form for electron beams with kinetic energies of from 1 to 50 MeV: the average current density in a stabilized beam runs from 0.13 to 160 a/cm^2; beam current for a 10 cm radius; stabilized beam power density ranges from 0.13 to 8,100 MW/cm^2, and the figures are also given for the space charge compensation time and time for the compression of the plasma ion shell, where the latter run from 1,000 to 28 ns respectively. The current level in a stabilized (nonexpanding) beam with a radius of 1 m exceeds 10^6 a for electron energies of more than 22 MeV. Stabilizing factors due to the earth's magnetic field and polarized plasma at different altitudes in the daytime and nighttime atmosphere are analyzed. An expression showing the limitation on the average current density in a stabilized beam is given. References 3: 1 Russian; 2 Western.
[104-8225]

NUCLEAR PHYSICS

USSR UDC 621.384.6

THE LIU-10 HIGH-POWER ELECTRON ACCELERATOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 250 No 5, 1980 pp 1118-1122 manuscript received 9 Oct 79

PAVLOVSKIY, A. I., BOSAMYKIN, V. S., SAVCHENKO, V. A., KLEMENT'YEV, A.P., MORUNOV, K.A., NIKOL'SKIY, V.S., GERASIMOV, A.I., TANANAKIN, V.A., BASMANOV, V.F., ZENKOV, D.N., SELEMIR, V.D. and FEDOTKIN, A.S.

[Abstract] The LIU-10 high-power electron accelerator, first introduced in 1977, represents a new trend in accelerator technology: a linear induction accelerator in which the possibility of varying the acceleration energy with variation in the scale of the accelerating system is combined with the presence of heavy current of a magnitude associated with the direct discharge of low-impedance distributed-parameter lines. The LIU-10 is based on a high-power multielement acceleration system that includes ~400 subnanosecond-precision spark dischargers commuting low-impedance (~1 ohm) radial lines. The system consists of 14 series-connected modules, each contributing ~1 MeV to the electron acceleration energy. The acceleration of the charged particles can take place either during the first or during the second accelerating-voltage pulse from the inductors. Output parameters: limiting electron energy 13.5 MeV, current-pulse amplitude of electron beam 50 ka; maximum duration of current pulses 20 or 40 ns. Figures 2; references 5 Russian. [119-1386]

USSR

ACCELERATION OF THERMAL NEUTRONS BY ISOMERIC ^{152m}Eu NUCLEI

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 31, No 4, 20 Feb 1980 pp 254-257 manuscript received 14 Jan 80

KONDUROV, I. A., KOROTKIKH, YE. M. and PETROV, YU. V., Institute of Nuclear Physics imeni V. P. Konstantinov, Academy of Sciences USSR

[Abstract] When neutrons interact with nuclei in the excited state, inelastic scattering is possible with a noticeable cross section, the excitation energy being transferred to the scattered neutron. For example, calculations for the isomers ^{113m}In and ^{155m}In with lifetimes measured in hours, and also conversion of experimental data on the reverse reaction give a cross section of about 0.1 b in the energy region of ~0.1 MeV for inelastic acceleration. However, the direct reaction of neutron acceleration has not yet been observed experimentally, despite numerous attempts. This paper gives the results of measurements in which acceleration of thermal neutrons was observed

on ^{152m}Eu nuclei. It is found that $\sigma_{in}=0.28\pm0.06$ b at a velocity of 2200 m/s for the thermal neutron flux. It is shown that the forbiddenness of the nuclear transition $^{152m}\mathrm{Eu}\rightarrow{}^{152g}\mathrm{Eu}$ is insignificant, whereas the γ-transition is slowed by a factor of more than 10^6-10^8 in the (n, n") reaction. The authors thank O. I. Sumbayev for constructive comments, and also G. Ya. Vasil'yev, A. I. Yegorov, Yu. Ye. Loginov, A. M. Nikitin, L. M. Ploshchanskiy, A. I. Shlyakhter, A. F. Shchebetov and reactor personnel for assistance with the work. Figures 2, references 12: 7 Russian, 5 Western.
[127-6610]

USSR

RESONANT RAMAN SCATTERING IN ZnTe AT HIGH EXCITATION LEVELS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 31, No 4, 20 Feb 1980 pp 230-234 manuscript received 14 Jan 80

VALAKH, M. YA. and KORNEYCHUK, V. A., Institute of Semiconductors, Academy of Sciences UkrSSR

[Abstract] In polar semiconductors with high carrier concentration where the plasma frequency w_p is comparable to the longitudinal optical phonon frequency w_{LO}, resonant interaction is observed with the formation of mixed plasmon-phonon modes. When the plasma frequency is low compared with w_{LO}, interaction shows up mainly in broadening of the LO-phonon line. As the carrier concentration increases and w_p approaches w_{LO}, the mixed plasmon-phonon mode shifts toward greater frequencies. This effect has been previously studied in detail for heavily doped semiconductors. The authors consider plasmon-phonon interaction in the nonequilibrium case with resonant two-photon excitation in ZnTe single crystals. When a certain excitation level is reached, the Raman spectrum shows a new band (L_+) that can be attributed to stimulation of a nonequilibrium electron-hole plasma that interacts with LO-phonons to produce bound plasmon-phonon modes. At the same time, there is a sharp rise of intensity of the TO and 2TO lines, and the spectrum of two-phonon transitions 2LO decreases in width, indicating intensification of resonant interaction. Two mechanisms are suggested: 1. a reduction in the width of the forbidden band due to exchange and correlation interaction; 2. intensification of the contribution made by a bound exciton-phonon complex to the process of resonant Raman scattering. Figures 2, references 8: 5 Russian, 3 Western.
[127-6610]

STRESS, STRAIN AND DEFORMATION

USSR UDC 539.375:678.01

ON THE QUESTION OF THE ACCUMULATION OF DAMAGE IN POLYMERS

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA - MATEMATIKA-MEKHANIKA-ASTRONOMIYA in Russian No 13, Jul 79 pp 80-83 manuscript received 2[illegible] Mar 78

KASATKIN, K.G.

[Abstract] The accumulation of irreversible microstructural damage in spatially cross-linked polymers is analyzed theoretically for the one-dimensional case of the deformation of a cylindrical rod by compression and tension. Irreversible damage is defined as true residual deformation which does not disappear, no matter how long the load has been removed. The analysis considers the following factors: the behavior of the majority of polymer materials obeys the principle of "decaying memory;" the accumulation of damage is closely related to the phenomenon of creep, where the bulk of microstructural damage occurs during steady-state creep; and there is a critical value of the stress, below which damage does not accumulate. Parameters characterizing the change in the microstructure are proposed, as are simple analytical expressions for the true irreversible deformation related to the damage and for the rate of microstructural damage accumulation. Additional experimental data is needed to further ascertain the properties of the proposed functions and determine the requisite number and structure of the parameters describing the microstructural state. References: 8 Russian.
[104-8225]

USSR UDC 530.145:519.2

THE GROUP EXPANSION METHOD IN QUANTUM KINETIC THEORY

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 24 No 2 1980 pp 140-142
manuscript received 8 Jun 79

KRUGLOV, V. I., Institute of Physics, BSSR Academy of Sciences

[Abstract] A mathematical technique is presented which considerably simplifies derivation of collision integrals of kinetic quantum equations. A previously developed group expansion is used alongside the method of successive elimination of irreducible means in any order of perturbation theory. An appropriate theorem is given which may also be used with the Feynman diagram method, where this theorem will play a role analogous to the Wick theorem in equilibrium statistical mechanics. References 7 Russian.
[100-1015]

- END -

SELECTIVE LIST OF JPRS SERIAL REPORTS

USSR SERIAL REPORTS (GENERAL)

USSR REPORT: Agriculture
USSR REPORT: Economic Affairs
USSR REPORT: Construction and Equipment
USSR REPORT: Military Affairs
USSR REPORT: Political and Sociological Affairs
USSR REPORT: Energy
USSR REPORT: International Economic Relations
USSR REPORT: Consumer Goods and Domestic Trade
USSR REPORT: Human Resources
USSR REPORT: Transportation
USSR REPORT: Translations from KOMMUNIST*
USSR REPORT: PROBLEMS OF THE FAR EAST*
USSR REPORT: SOCIOLOGICAL STUDIES*
USSR REPORT: USA: ECONOMICS, POLITICS, IDEOLOGY*

USSR SERIAL REPORTS (SCIENTIFIC AND TECHNICAL)

USSR REPORT: Life Sciences: Biomedical and Behavioral Sciences
USSR REPORT: Life Sciences: Effects of Nonionizing Electromagnetic Radiation
USSR REPORT: Life Sciences: Agrotechnology and Food Resources
USSR REPORT: Chemistry
USSR REPORT: Cybernetics, Computers and Automation Technology
USSR REPORT: Electronics and Electrical Engineering
USSR REPORT: Engineering and Equipment
USSR REPORT: Earth Sciences
USSR REPORT: Space
USSR REPORT: Materials Science and Metallurgy
USSR REPORT: Physics and Mathematics
USSR REPORT: SPACE BIOLOGY AND AEROSPACE MEDICINE*

WORLDWIDE SERIAL REPORTS

WORLDWIDE REPORT: Environmental Quality
WORLDWIDE REPORT: Epidemiology
WORLDWIDE REPORT: Law of the Sea
WORLDWIDE REPORT: Nuclear Development and Proliferation
WORLDWIDE REPORT: Telecommunications Policy, Research and Development

*Cover-to-cover

END OF
FICHE
DATE FILMED

7 May '80

MAK